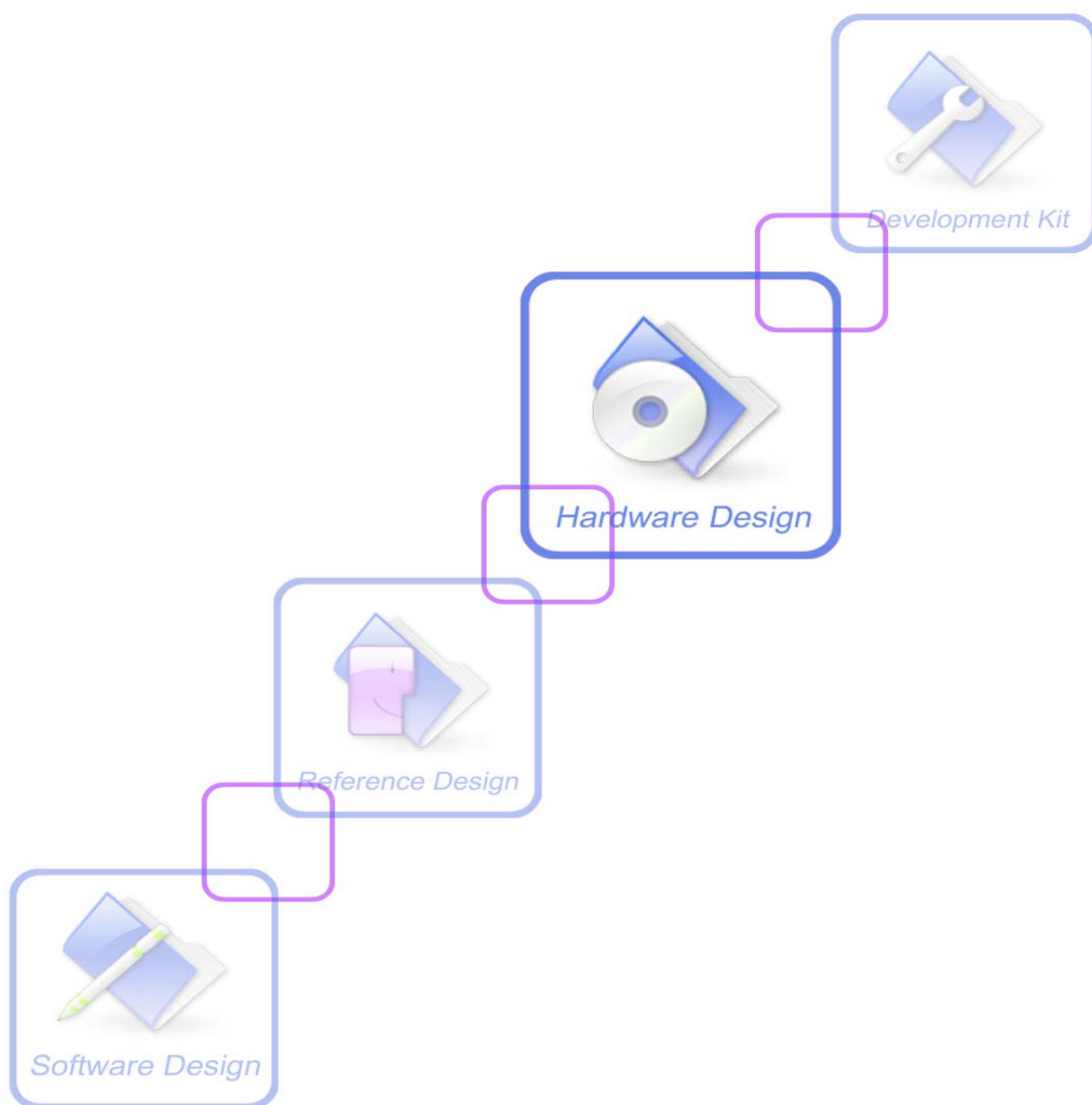




A company of SIM Tech

T5320_User Guide_V1.02



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Contents

Contents.....	3
Version History.....	6
1 Introduction.....	7
2 Key features.....	7
3 Terminal dimensions	9
4 Installation.....	10
5 Interface introduction.....	10
5.1 Overview	10
5.2 T5320 Functional Diagram.....	11
5.3 Accessory information.....	12
6 Application Interface.....	13
6.1 Power Supply.....	13
6.2 Serial Interface.....	14
6.3 10 PIN I/O interface	15
6.3.1 Audio interface.....	17
6.3.2 ADC channel.....	18
6.3.3 GPIO interfaces.....	19
6.4 LED indicator	20
6.5 Micro USB interface.....	21
6.6 USIM Card Interface	22
6.7 Antenna interface.....	23
6.7.1 Antenna connector	23
6.7.2 Antenna type	23
6.7.3 Antenna placement.....	23
7 Electrical, Reliability and Radio Characteristics.....	24
7.1 Absolute Maximum Ratings.....	24
7.2 Recommended Operating Conditions.....	24
7.3 Electro-Static Discharge	24
7.4 Operating frequency	25
7.5 Transmitter output power and receiver sensitivity	25
8 Software/ Firmware Upgrade	25
8.1 Tool introduction.....	26
8.2 Illustration of software updating.....	26
Appendix	29
A. Related Documents.....	29
B. Terms and Abbreviations	30
C. Safety Caution	31

Table Index

TABLE 1: T5320 KEY FEATURES.....	8
TABLE 2: THE POWER LINE ASSIGNMENT.....	13
TABLE 3: 9-POLE D-SUB (FEMALE) RS-232.....	14
TABLE 4: SIGNAL ASSIGNMENT OF 10 PIN CABLE	16
TABLE 5: MIC INPUT CHARACTERISTICS	17
TABLE 6: SPEAKER OUTPUT CHARACTERISTICS	17
TABLE 7: AUDIO PARAMETER	17
TABLE 8: ADC SPECIFICATION	18
TABLE 9: AT+CADC READ ADC.....	18
TABLE 10: T5320 GPIOs.....	19
TABLE 11: STATUS OF THE NETLIGHT INDICATOR (GREEN).....	20
TABLE 12: AT+CUSBSPD SWITCH T5320 USB HIGH OR FULL SPEED.....	21
TABLE 13: ANTENNA CHOOSING CONSIDERATION.....	23
TABLE 14: ABSOLUTE MAXIMUM RATINGS.....	24
TABLE 15: RECOMMENDED OPERATING CONDITIONS	24
TABLE 16: THE ESD CHARACTERISTICS (TEMPERATURE: 25°C, HUMIDITY: 45 %).....	24
TABLE 17: OPERATING FREQUENCY.....	25
TABLE 18: TRANSMITTER OUTPUT POWER AND RECEIVER SENSITIVITY	25
TABLE 19: RELATED DOCUMENTS	29
TABLE 20: TERMS AND ABBREVIATIONS.....	30
TABLE 21: SAFETY CAUTION.....	31

Figure Index

FIGURE 1: T5320 OVERVIEW	7
FIGURE 2: MECHANICAL DIMENSIONS OF T5320 (UNIT: MM)	9
FIGURE 3: INSTALLATION OF THE TERMINAL	10
FIGURE 4: T5320 INTERFACE FRONT VIEW	11
FIGURE 5: T5320 INTERFACE BACK VIEW	11
FIGURE 6: T5320 FUNCTIONAL DIAGRAM	12
FIGURE 7: ACCESSORY INFORMATION	12
FIGURE 8: DIMENSIONS OF POWER LINE (UNIT: MM)	13
FIGURE 9: POWER INTERFACE	14
FIGURE 10: PIN ASSIGNMENT RS-232 (D-SUB 9-POLE FEMALE)	14
FIGURE 11: COM PORT PROPERTIES OF THE HYPER TERMINAL	15
FIGURE 12: SIGNAL ASSIGNMENT OF 10PIN I/O PORT	16
FIGURE 13: DIMENSIONS OF 10-LINE CABLE	16
FIGURE 14: SPEAKER REFERENCE CIRCUIT	17
FIGURE 15: INDICATOR LED	20
FIGURE 16: MICRO USB INTERFACE	21
FIGURE 17: INSTALLATION OF SIM CARD	22
FIGURE 18: ANTENNA INTERFACE	23
FIGURE 19: <i>VIRTUAL PORTS IN COMPUTER MANAGER WINDOW</i>	26
FIGURE 20: QDL WINDOW	26
FIGURE 21: BROWSE THE SOURCE FILE	27
FIGURE 22: CLICK DOWNLOAD BUTTON WITHOUT POWER UP	27
FIGURE 23: UPGRADE IN PROCEEDING	28
FIGURE 24: FINISH UPGRADING	28

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2012-07-23	1.01	Origin	Libing
2012-08-10	1.02	Figure 1 & Figure 11 are replaced to new pictures.	Libing

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1 Introduction

This document describes features, functions and interfaces of T5320 terminal in great detail.

T5320 is a quad-band GSM/GPRS/EDGE and dual-band UMTS /HSDPA that works on frequencies of GSM 850MHz, EGSM 900 MHz, DCS 1800 MHz, PCS 1900MHz and WCDMA 2100/900MHz, which is a ideal solution for wireless m2m applications, the terminal features HSDPA Category 5/6 -3.6 Mbps.

With the help of this document user can understand T5320 interface specifications, electrical and mechanical quickly.



Figure 2: T5320 overview



Note: The T5320 Terminal is fully complying with RoSH following requirements of European standards.

2 Key features

T5320 terminal terminal has the following features:

1. Standard AT commands set
2. SIMCom proprietary AT commands set
3. watch-dog function
4. Short circuit protection
5. Voice call
6. GPIOs
7. ADC function

Table 1: T5320 key features

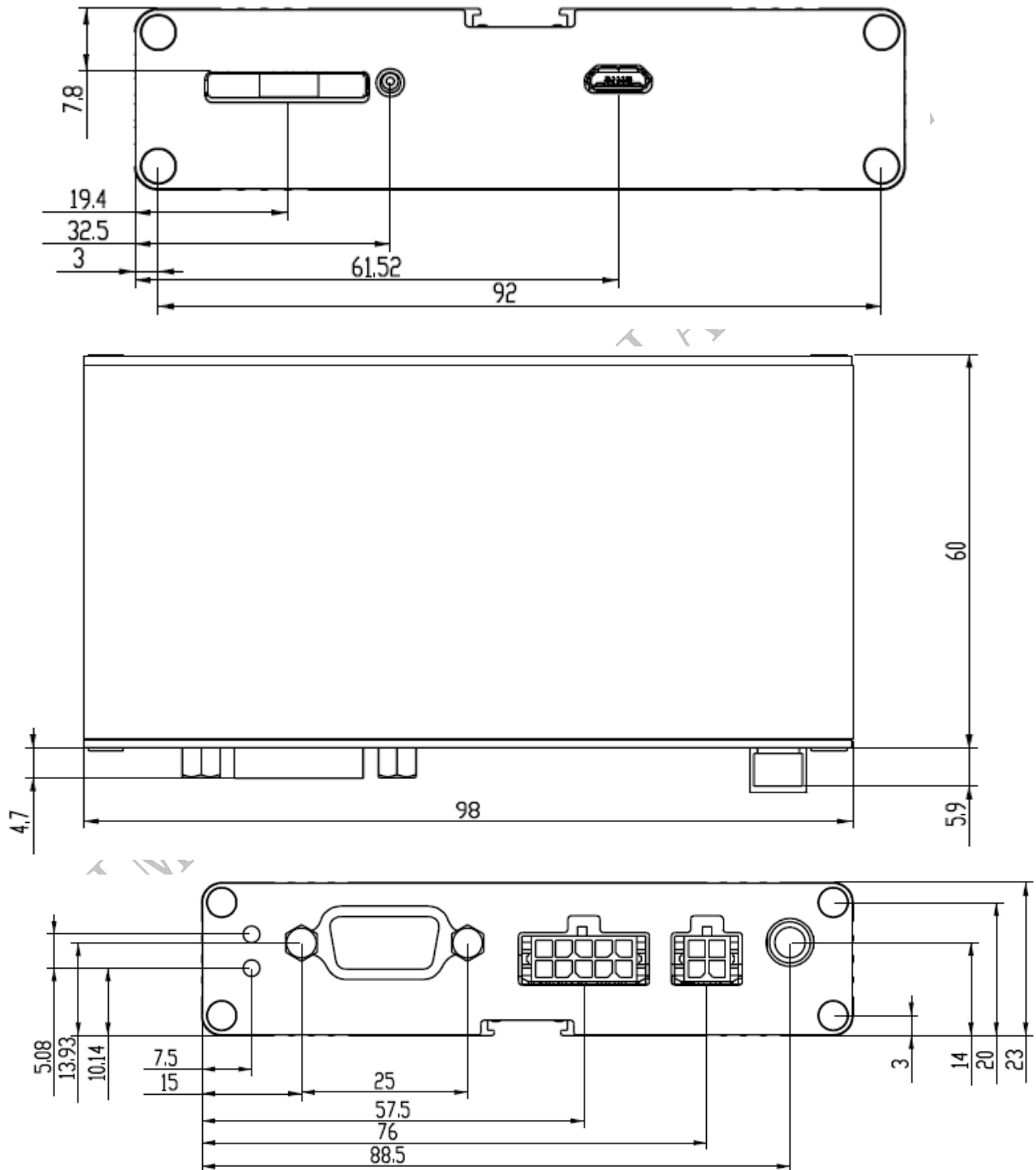
Feature	Implementation
Power supply	5V ~ 30V
Transmission data	<ul style="list-style-type: none"> ● Dual-mode UMTS/HSDPA/EDGE/GPRS operation ● GPRS Class B, multislot class 12 operation, Supports coding scheme: CS1-4 ● EDGE multislot class 12 operation, Supports coding schemes MSC1-9 ● UMTS R99 data rates-384 kbps DL/UL ● HSDPA Category 5/6 -3.6 Mbps and Category12-1.8 Mbps ● Integrate the TCP/IP protocol
Transmitting power	<ul style="list-style-type: none"> ● Class 4 (+33dBm) for GSM850 and EGSM900 ● Class 1 (+30dBm) for DCS 1800 PCS GSM1900 ● Class 3 (+24dBm) for WCDMA 2100, WCDMA FDD BDI ● Class 3 (+24dBm) for WCDMA 900, WCDMA FDD BDVIII
Temperature range	<ul style="list-style-type: none"> ● Normal operation: -30°C ~ +75°C ● Restricted operation: -35°C ~ -30°C and +75 °C ~ +80°C* ● Storage temperature -40°C ~ +85°C
CSD	<ul style="list-style-type: none"> ● CSD feature: 9.6, 14.4, 64 kbps UL/DL
SMS	<ul style="list-style-type: none"> ● MT, MO, CB, Text and PDU mode ● SMS storage: SIM card ● Support transmission of SMS alternatively over CSD or GPRS. User can choose preferred mode.
FAX	Group 3 Class 1
USIM interface	Support USIM card: 1.8V, 3V
External antenna	SMA type RF connector
Audio features	Speech codec modes: <ul style="list-style-type: none"> ● Half Rate (ETS 06.20) ● Full Rate (ETS 06.10) ● Enhanced Full Rate (ETS 06.50 / 06.60 / 06.80) ● AMR (WCDMA) ● AMR+QCP (GSM) ● A5/1, A5/2, and A5/3 ciphering
USB	Support USB2.0 Slave mode
RS232 serial port	Serial port: <ul style="list-style-type: none"> ● Full modem interface with status and control lines, unbalanced, asynchronous. ● 1200bps to 115200bps. ● Default rate is 115200bps. ● Can be used for AT commands data stream. ● Support RTS/CTS hardware handshake and software ON/OFF flow control. ● Multiplex ability according to GSM 07.10 Multiplexer Protocol.
Phonebook management	Support phonebook types: SM, FD, LD, RC, ON, MC.
SIM application toolkit	Support SAT class 3, GSM 11.14 Release 98 Support USAT
Physical characteristics	Size: 98*60*23mm Weight: 128g

Firmware upgrade

Firmware upgradeable by USB interface

* T5320 does work at this temperature, but some radio frequency characteristics may deviate from the GSM specification.

3 Terminal dimensions



4 Installation

The terminal can be fixed by two kickstands (Optional) that provided by SIMCom, the following figure is the illustration.

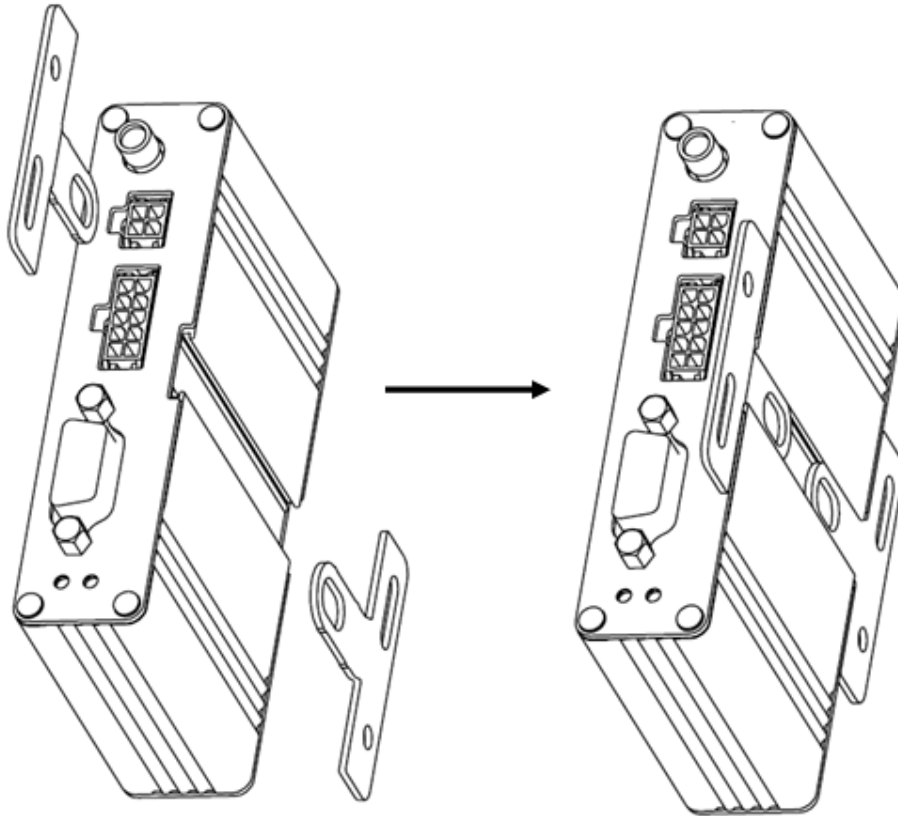


Figure 4: Installation of the terminal

5 Interface introduction

5.1 Overview

T5320 Terminal provides the following connectors for power supply, GPIOs, Audio, ADC, Serial port and antenna:

- The GSM/WCDMA antenna interface(SMA type female connector)
- The 4 PIN I/O port for power supply
- The 10 PIN I/O port for audio, GPIOs and ADC
- The standard RS232 interface
- LED indicator for power (Red) and GSM/WCDMA netlight (Green)
- USIM card holder
- Micro USB interface



Figure 5: T5320 interface Front view

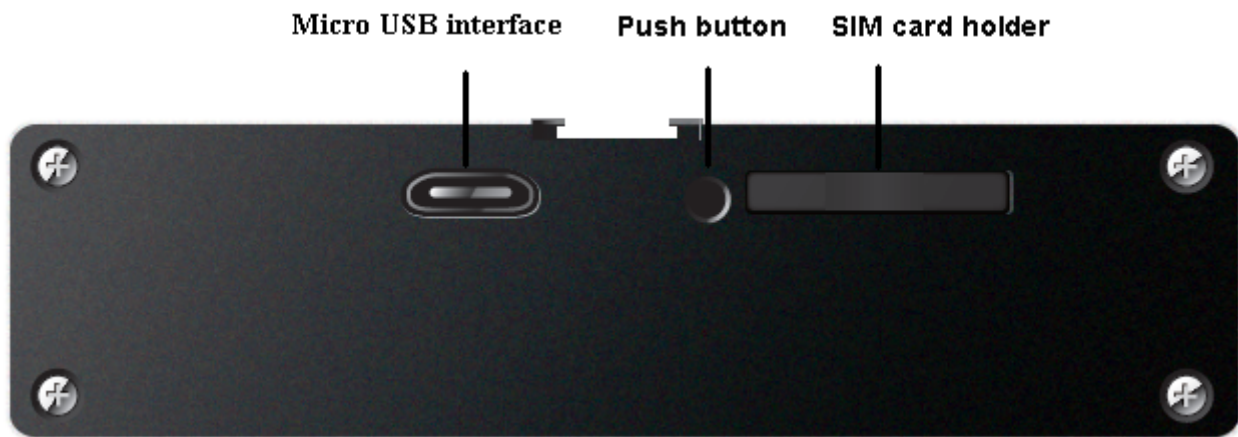


Figure 6: T5320 interface Back view

Note: For the I/O interface, SIMCom provides 4-line cable and 10-line cable (optional) to assist developers, it will be introduced at the following chapter.

5.2 T5320 Functional Diagram

The following figure shows a functional diagram of T5320 and typical accessories.

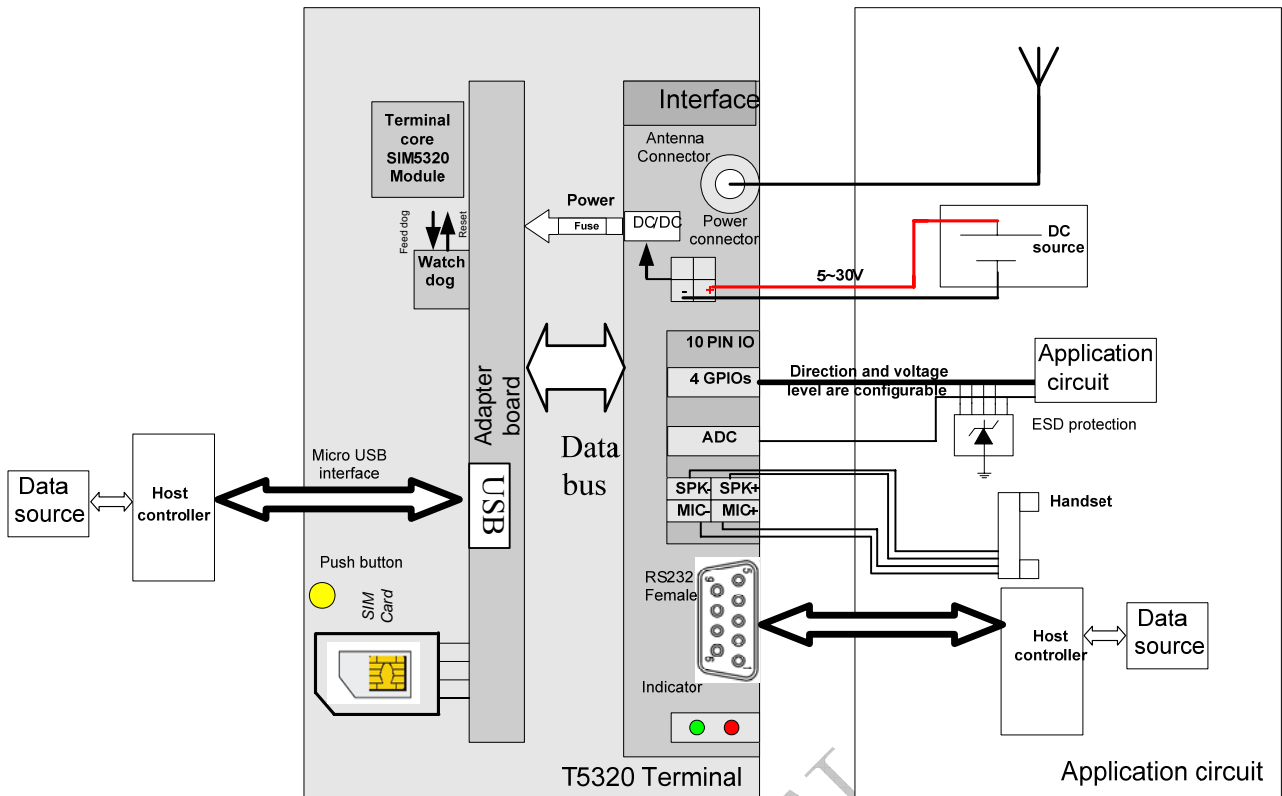


Figure 7: T5320 functional diagram

5.3 Accessory information

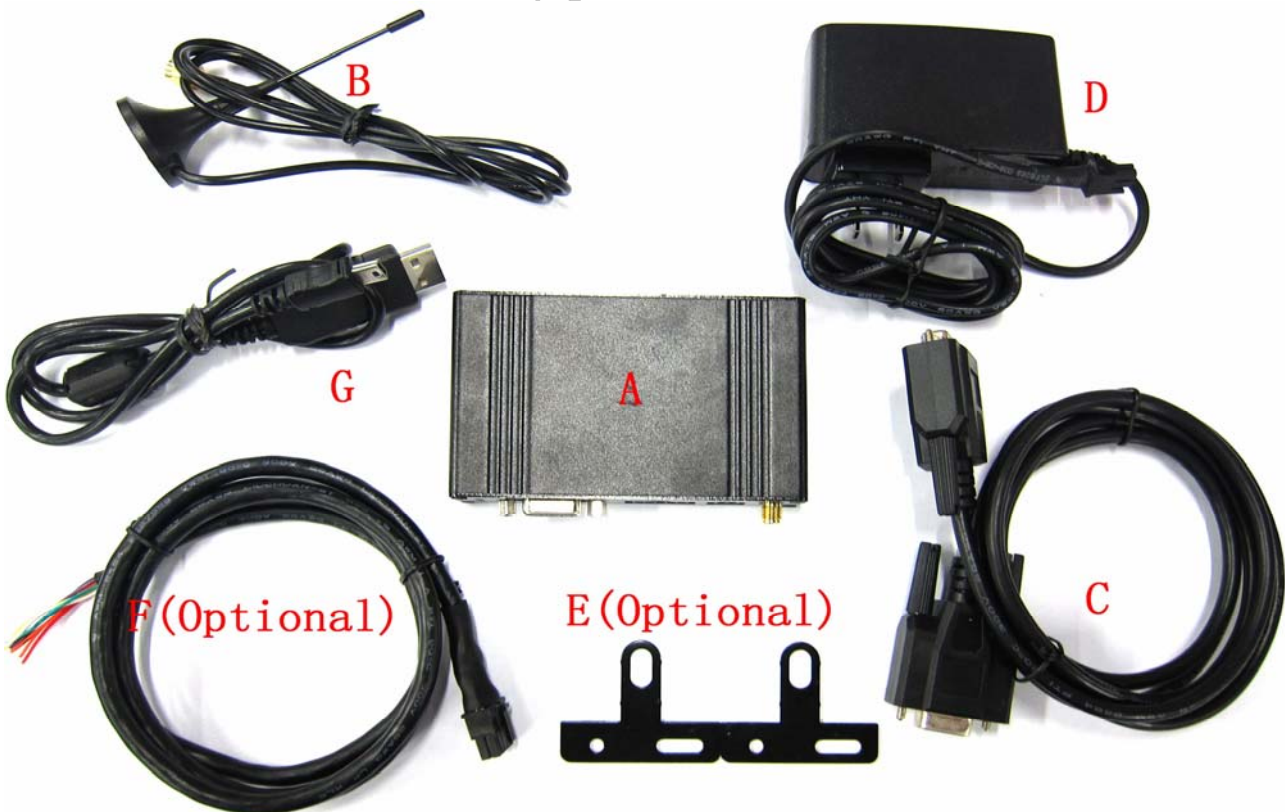


Figure 8: Accessory information

- A: T5320 Terminal
- B: GSM Antenna
- C: Male to Female DB9 Line
- D: 5V Adapter
- E: Two kickstands (Optional)
- F: 10-Line cable (Optional)
- E: Micro-USB cable

6 Application Interface

6.1 Power Supply

Customer can use the DC adapter that SIMCom provides as the power source.

If customer does not use the adapter, then DC source should be satisfied with the following requirements.

- Input voltage range 5-30V
- Normal voltage 12V
- Current ability 1A

The following chapter introduces the power line that SIMCom provides to customers, customer can power the terminal by connect the terminal to the DC source via this line.

The power line includes four lines as the following figure shows, and table 3 gives a detailed description.

Table 2: The power line assignment

PIN Number	Colour	Item
1	white	NC
2	Red	Power
3	Yellow	NC
4	Black	Ground

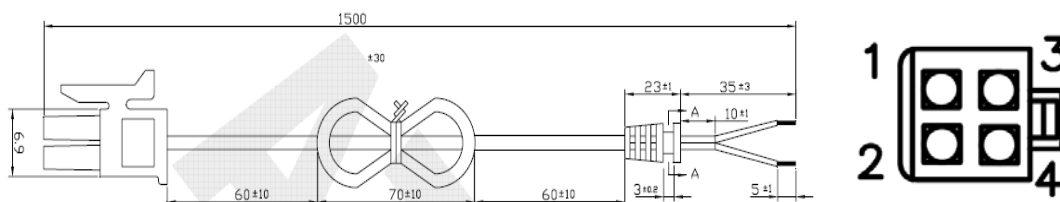


Figure 9: dimensions of power line (Unit: mm)

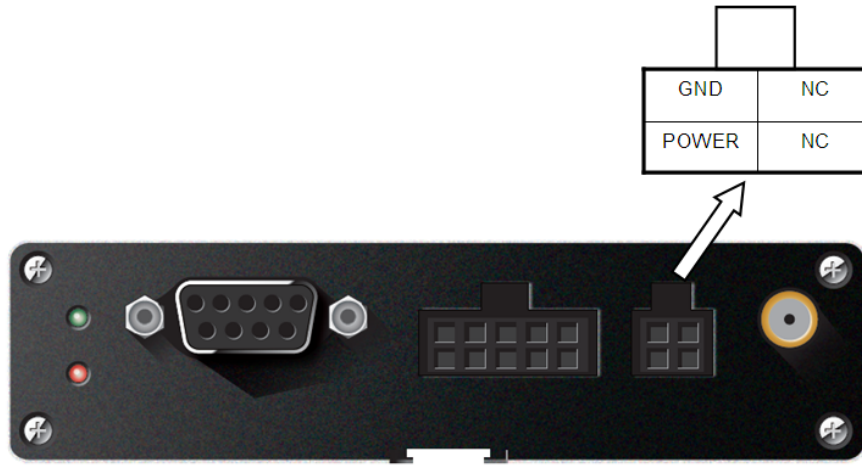


Figure 10: Power interface

When a valid power appears the terminal will power up automatic, for the MCU that inside the terminal processed the power up part, MCU also acts as a Watch Dog, when the terminal runs wrong, MCU will cut off the power and recover it immediately to restart the terminal.

6.2 Serial Interface

T5320 provides one asynchronous RS232 serial port (female). The RS232 standard interface serves to connect a PC, Data Terminal Equipment (DTE) or other application, which acts as host controller of the T5320 Terminal with all its functions. Through the RS232 interface it can be used as GSM/GPRS modem for sending and receiving of SMS, Data and Fax calls.



Figure 11: Pin assignment RS-232 (D-Sub 9-pole female)

Table 3: 9-pole D-Sub (female) RS-232

Pin no	Signal name	I/O	Function
1	DCD	O	Data Carrier Detected
2	RXD	O	Receive Data

3	TXD	I	Transmit Data
4	DTR	I	Data Terminal Ready Attention: The ignition of T5320 Terminal is activated via a rising edge of high potential (+3 ... +15 V)
5	GND	-	Ground
6	DSR	O	Data Set Ready
7	RTS	I	Request To Send
8	CTS	O	Clear To Send
9	RING	O	Ring Indication

Note: User can use AT command “AT+IPR=x” to set a fixed baud rate and the setting will be saved to non-volatile flash memory automatically. After the configuration is set as fixed baud rate, the URC such as “RDY”, “+CFUN: 1” and “+CPIN: READY” will be reported when T5320 is powered on.

Hyper terminal usually as the PC software tool to operate T5320; customer can set up a connection between PC and terminal, configure the port properties as the figure 9 shows.

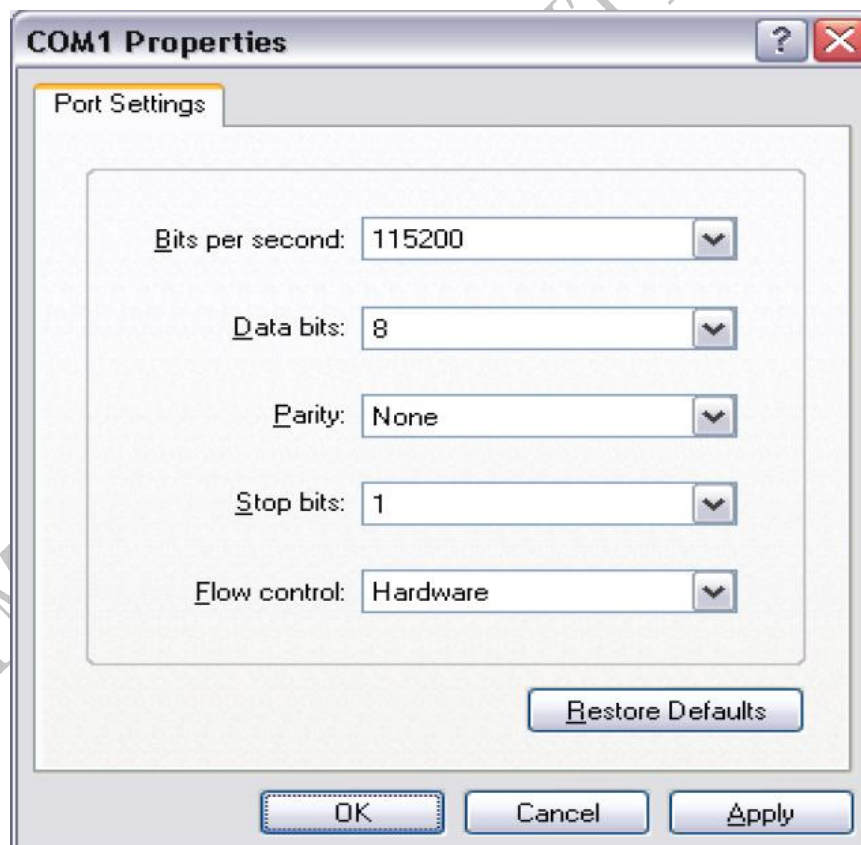


Figure 12: COM port properties of the hyper terminal

6.3 10 PIN I/O interface

T5320 provides a 10 PIN I/O interface for customer use, including Audio, GPIOs and 1 ADC channel. The following figure gives a brief view of signal assignment.

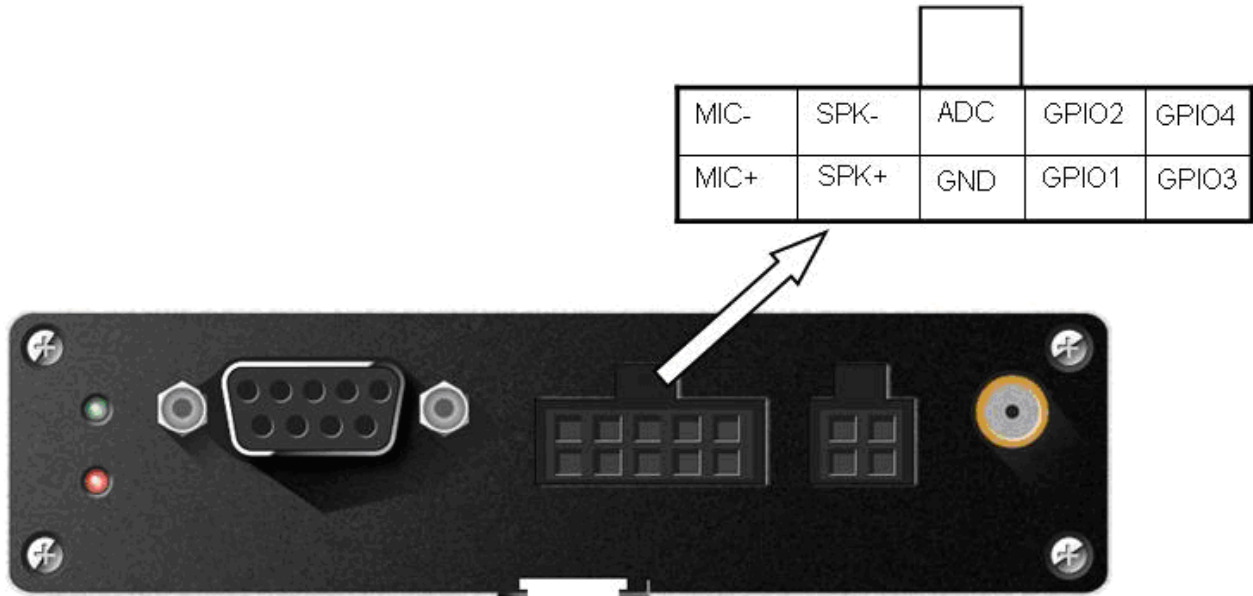


Figure 13: signal assignment of 10PIN I/O port

To make the usage conveniently, SIMCom provides a cable for customer, it can be inserted to the 10 PIN I/O port so customer can develop their application by connecting some devices.

Figure 11 shows the specification of cable.

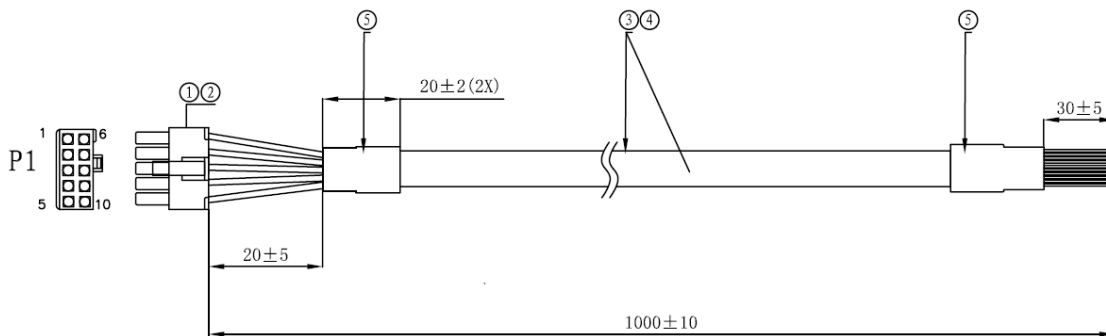


Figure 14: Dimensions of 10-line cable

Table 4: signal assignment of 10 pin cable

Connecting diagram					
P1	Wire color and cutting length		Terminal signal		
			Signal name	I/O	Command
1	Green	1007 26#	GPIO3	I/O	Configurable by AT commands
2	Yellow		GPIO1	I/O	
3	Black		GND		Ground
4	Orange		SPK+	O	
5	Brown		MIC+	I	
6	White		GPIO4	I/O	Configurable

7	Gray		GPIO2	I/O	by AT commands
8	Red		ADC	I	
9	Purple		SPK-	O	
10	Blue		MIC-	I	

6.3.1 Audio interface

T5320 has one pair of audio input and audio output; it can be connected to a speakerphone directly.

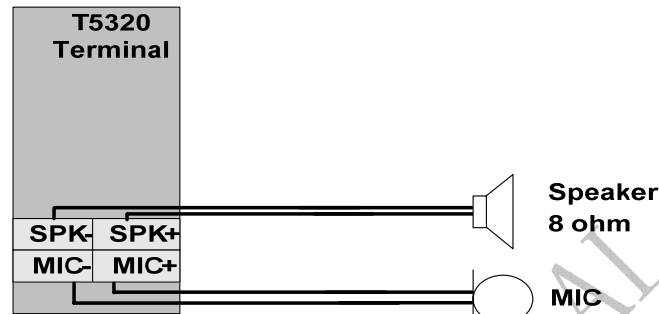


Figure 15: Speaker reference circuit

Customer can set the terminal MIC gain level to make the sounds louder so that the listener can hear more clearly. And if the sound a little lower on the terminal side, customer can use the “AT +CLVL” to make the sound higher so that customer can hear clearly.

The AT commands should be send to the terminal by RS232 or USB interface, and the following table shows the detail commands.

Table 5: MIC input characteristics

Parameter	Min	Typ	Max	Unit
Working Voltage	-	1.8	-	V
Working Current	0.07	0.4	1	mA
External Microphone Load Resistance	1.2	2.2		k Ohms

Table 6: Speaker output characteristics

Parameter	Min	Typ	Max	Unit
Quiescent Current	-	2.5	4	mA
Load resistance	-	8	-	Ohm
Output power(1KHz)	-	500	-	mW

Table 7: Audio parameter

Parameter	Influence to	Range	Gain range	Calculation	AT command
micAmp1	MICP/MICN analogue amplifier	0...1	0...24dB	2 steps	AT+CMICAMP1

	gain before ADC				
txVol	Digital gain of input signal after ADC	0, 1...65535	Mute, -84...+12dB	$20 * \log (txVol/16384)$	AT+CTXVOL
txGain	Digital gain of input signal after summation of sidetone	0, 1...65535	Mute, -84...+12dB	$20 * \log (txGain/16384)$	AT+CTXGAIN
txFilter	Input PCM 13-tap filter parameters, 7 values	0...65535	---	MATLAB calculate	AT+CTXFTR
rxGain	Digital gain of output signal after summation of sidetone	0, 1...65535	Mute, -84...+12dB	$20 * \log (rxGain/16384)$	AT+CRXGAIN
rxVol	Digital Volume of output signal after speech decoder, before summation of sidetone and DAC	-300...300	dbm	-300...300dbm	AT+CLVL AT+CVLVL AT+CRXVOL
stGain	Digital attenuation of sidetone	0, 1...65535	Mute, -96...0dB	$20 * \log (stGain/16384) - 12$	AT+SIDET
rxFilter	Output PCM 13-tap filter parameters, 7 values	0...65535	---	MATLAB calculate	AT+CRXFTR

Please refer to *document [1]* and *document [3]* for details.

6.3.2 ADC channel

T5320 provides an auxiliary ADC, which can be used to measure the voltage. User can use AT command “AT+CADC=2” to read the voltage value.

Table 8: ADC specification

Parameter	Min	Typ	Max	Unit
Voltage range	0	-	2.2	V
ADC Resolution	-	12	-	bits
Sampling rate	-	-	200K	Hz

Note: the maximum voltage that the ADC can gather is 2.2V

Table 9: AT+CADC Read ADC

Description

Read the ADC value from modem. We support 3 type of ADC, raw type, temperature type and voltage type.

SIM PIN	References
NO	Vendor

Syntax

Test Command	Responses
AT+CADC=?	+CADC: (range of supported <adc>s) OK
Write Command	Responses
AT+CADC=<adc>	+CADC: <value> OK ERROR
Execution Command	Responses
AT+CADC	<i>Same as AT+CADC= 0:</i> +CADC: <value> OK

Defined values

<adc>
ADC type:
0 - raw type.
1 - temperature type.
2 - voltage type(mv)
<value>
Integer type value of the ADC.

Examples

AT+CADC=?
+CADC:(0-2)
OK
AT+CADC=0
+CADC: 187
OK

6.3.3 GPIO interfaces

T5320 provides 4 GPIO pins. All GPIOs can be configured as inputs or outputs. User can use AT Commands to read or write GPIOs status. Refer to *document [1]* for details.

Table 10: T5320 GPIOs

T5320 GPIO	CPU Pin No.	I/O	Function
------------	-------------	-----	----------

GPIO1	GPIO0	I/O	General input/output PIN. It can be used as wake/interrupt signal to host from module If it is unused, left open.
GPIO2	GPIO2	I/O	General input/output PIN.
GPIO3	GPIO3	I/O	General input/output PIN.
GPIO4	GPIO5	I/O	General input/output PIN.

Example 1: If user use T5320 GPIO1 pin as an output GPIO:

- 1) AT+CGFUNC=9,0 //close wake up module function, only disable the function can this pin be used as GPIO
- 2) AT+CGDRT=0,1 //set T5320 GPIO1 to output
- 3) AT+CGSETV=0,1 //set T5320 GPIO1 to high value

Example 2: If user use T5320 GPIO4 pin as an input GPIO:

- 1) AT+CGDRT=5,0 //set T5320 GPIO4 to output

Please refer to *document [1]* and *document [2]* for details.

6.4 LED indicator

A red led indicates the power status, when a valid power appears, the red led will lighten up. But a lighten up red led does not mean that the terminal has been powered up.

A green led indicates the terminal status and GSM net status, after the terminal been powered up and registered to the network, it will blink at a certain frequency.

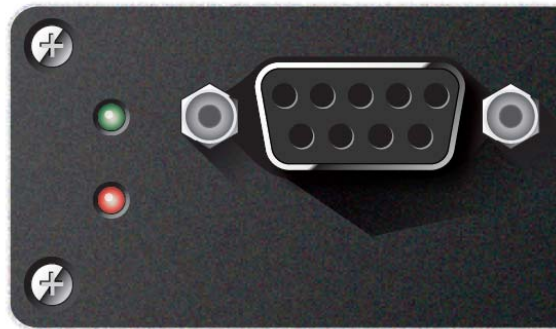


Figure 16: Indicator LED

Table 11: Status of the NETLIGHT indicator (Green)

LED Status	T5320 behavior
Always On	Searching Network/Call Connect
200ms ON, 200ms OFF	Data Transmit
800ms ON, 800ms OFF	Registered network
Off	Power off / Sleep

6.5 Micro USB interface

T5320 provides a Micro USB interface. This interface is compliant with the USB2.0 specification. The USB2.0 specification requires hosts such as the computer to support full-speed (12Mbps) and high-speed (480Mbps). USB charging and USB-OTG is not supported.

Micro USB interface



Figure 17: Micro USB interface

Table 12: AT+CUSBSPD Switch T5320 USB high or full speed

Description

This command is used to switch the speed of USB between high speed and full speed. If you just want to use full speed to simplify the circuit then you can use this command to switch the USB speed. This command will save your configuration so if you don't change the speed the module will use the latest configuration forever.

This command will only takes effect on the next start-up.

SIM PIN	References
NO	Vendor

Syntax

Test Command	Responses
AT+CUSBSPD=?	+CUSBSPD: (list of supported <speed>s) OK
Read Command	Responses
AT+CUSBSPD?	+CUSBSPD: <speed> OK
Write Command	Responses
AT+CUSBSPD=<speed>	OK ERROR

Defined values

<speed>
Integer type and nonvolatile value.

- 0 – High speed
- 1 – Full speed (default value)

Examples

```
AT+CUSBSPD=?
```

```
+CUSBSPD: (0-1)
```

```
OK
```

```
AT+CUSBSPD=0
```

```
OK
```

```
AT+CUSBSPD=1
```

```
OK
```

6.6 USIM Card Interface

The USIM provides the required subscription verification information to allow the mobile equipment to attach to a GSM or UMTS network. Both 1.8V and 3.0V SIM Cards are supported.

T5320 does not support USIM card “hot” plug.



Figure 18: Installation of SIM Card

6.7 Antenna interface

6.7.1 Antenna connector

Antenna connector allows transmission of radio frequency (RF) signals between the modem and the external supplied antenna. The T5320 modem is fitted with a 50Ω male SMA connector.



Figure 19: Antenna interface

6.7.2 Antenna type

The antenna is a very important component in the system. Since the antenna transmits and receives electromagnetic signal, and its efficiency depends on the antenna's type, placement and the environment of the antenna operating.

The recommended antenna specifications are showed in following table:

Table 13: antenna choosing consideration

Frequency range	GSM 850/900/1800/1900MHz WCDMA 2100/900MHz
Impedance	50 ohm
Input power	>33dBm (2W) peak power in GSM >24dBm (0.25W) peak power in WCDMA
VSWR absolute max.	≤10:1
VSWR recommended	≤2:1
Gain	< 3dBi

6.7.3 Antenna placement

The antenna performance is very easily influenced by other electronic devices. So the antenna placement should be considered carefully as follow.

1. Place away from other electronic devices or other antennas.
2. Place far away from metal material.
3. Face the base station antenna directly if the signal strength is very weak.

7 Electrical, Reliability and Radio Characteristics

7.1 Absolute Maximum Ratings

The absolute maximum ratings stated in following table are stress ratings under non-operating conditions. Stresses beyond any of these limits will cause permanent damage to T5320.

Table 14: Absolute maximum ratings

Symbol	Parameter	Min	Typ	Max	Unit
VBAT	Power supply voltage	4.5	-	30	V
V _I *	Input voltage	-0.3	-	2.8	V
I _I *	Input current	-	-	6	mA
I _O *	Output current	-	-	6	mA

*These parameters are for digital interface pins, such as GPIO, UART.

7.2 Recommended Operating Conditions

Table 15: Recommended operating conditions

Symbol	Parameter	Min	Typ	Max	Unit
VBAT	Power supply voltage	5	5	30	V
I _{IH}	High-level input current	-10	-	10	uA
I _{IL}	Low-level input current	-10	-	10	uA
V _{IH}	High-level input voltage	2.4	-	-	V
V _{IL}	Low-level input voltage	-	-	0.4	V
V _{OH}	High-level output voltage	2.6	-	-	V
V _{OL}	Low-level output voltage	-	-	0.1	V
T _{OPER}	Operating temperature	-35	+25	+80	°C
T _{STG}	Storage temperature	-40		+85	°C

7.3 Electro-Static Discharge

T5320 is an ESD sensitive component, so more attention should be paid to the procedure of handling and packaging. The ESD test results are shown in the following table.

Table 16: The ESD characteristics (Temperature: 25°C, Humidity: 45 %)

Pin	Contact discharge	Air discharge
Shell	±10KV	±15KV
RF interface	±10KV	±15KV
RS232 interface	±10KV	±15KV
Audio interface	±10KV	±15KV
SIM card holder	±10KV	±15KV

7.4 Operating frequency

The operating frequencies in GSM850, EGSM900, DCS, PCS and WCDMA modes are conform to the GSM/WCDMA Specifications, shown as bellow.

Table 17: Operating frequency

Mode	Freq.TX(MHz)	Freq.RX(MHz)	Channels(ARF C)	TX-RX offset
GSM-850	824.2 – 848.8	869.2 – 893.8	128 - 251	45 MHz
E-GSM-900	890.0-914.8	935.0-959.8	0–124	45M
	880.2-889.8	925.2 - 934.8	975-1023	45M
DCS-1800	1710.2-1784.8	1805.2-1879.8	512–885	95 MHz
PCS-1900	1850.2 - 1909.8	1930.2 - 1989.8	512 - 810	80 MHz
WCDMA 2100	1920 - 1980	2110 - 2170	9612 – 9888	60 MHz
WCDMA 900	880 - 915	925 - 960	2712 - 2863	35 MHz

7.5 Transmitter output power and receiver sensitivity

The T5320's conducted transmitter output power and receiver sensitivity are shown as bellow:

Table 18: Transmitter output power and receiver sensitivity

Mode	Power(dBm)	Sensitivity(dBm)
GSM-850	+33	-106
E-GSM-900	+33	-106
DCS-1800	+30	-107
PCS-1900	+30	-107
WCDMA2100	+24	-106
WCDMA900	+24	-106

8 Software/ Firmware Upgrade

The software can be upgraded via the Micro USB interface with the help of tools provided by SIMCom,

8.1 Tool introduction

The tool name is “SIMCOM 3G Module Software update tools(QDL)”, which runs on the windows OS, customers can upgrade software conveniently by it.

This tool is a single-road download tool, one terminal can be upgraded by it every time. SIMCom also provides multi-road download tools for customer’s factory use. Contact SIMCom sales for support.

Please do not power off T5320 during the upgrade,

8.2 Illustration of software updating

- Connect the Micro USB port of T5320 to the PC USB port and connect the direct current source adapter.
- Installing module USB driver on PC OS. *USB interface is mapped to five virtual ports: “SIMTECH USB Modem”, “SIMTECH NMEA Device”, “SIMTECH ATCOM Device”, “SIMTECH Diagnostics interface” and “SIMTECH Wireless Ethernet Adapter”.*

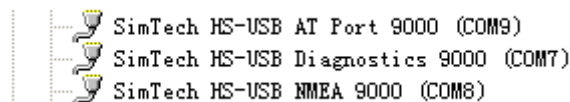


Figure 20: Virtual ports in computer manager window

- Open the tools, the main operation interface as the following figure shows:

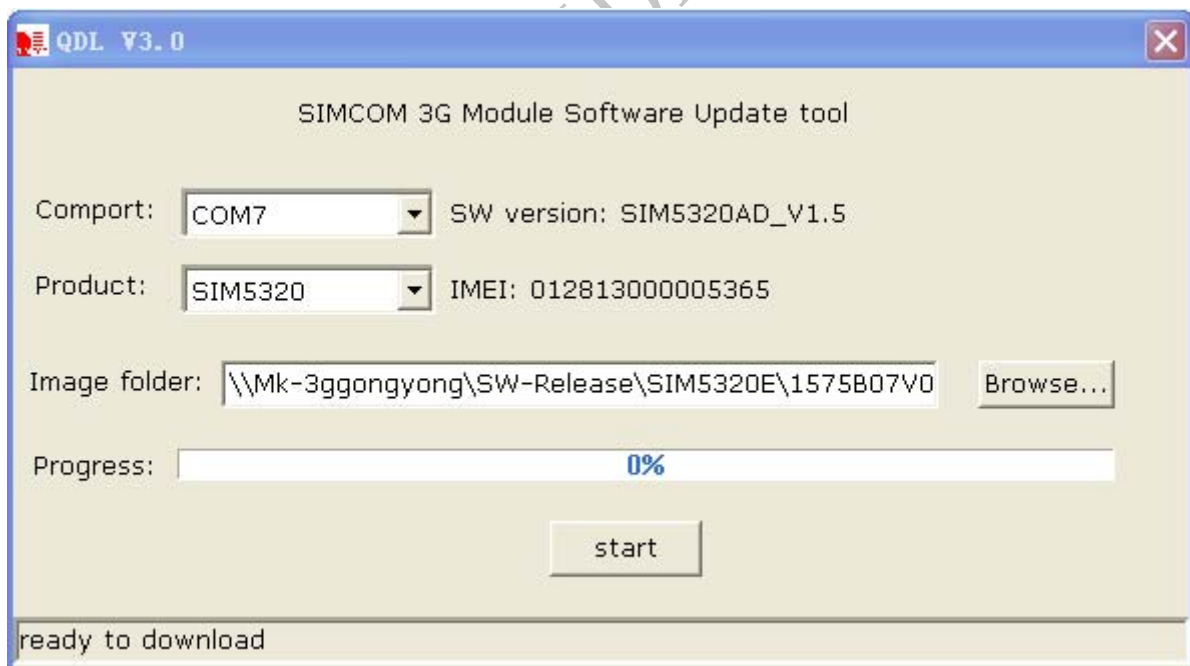


Figure 21: QDL window

- Browse the source file

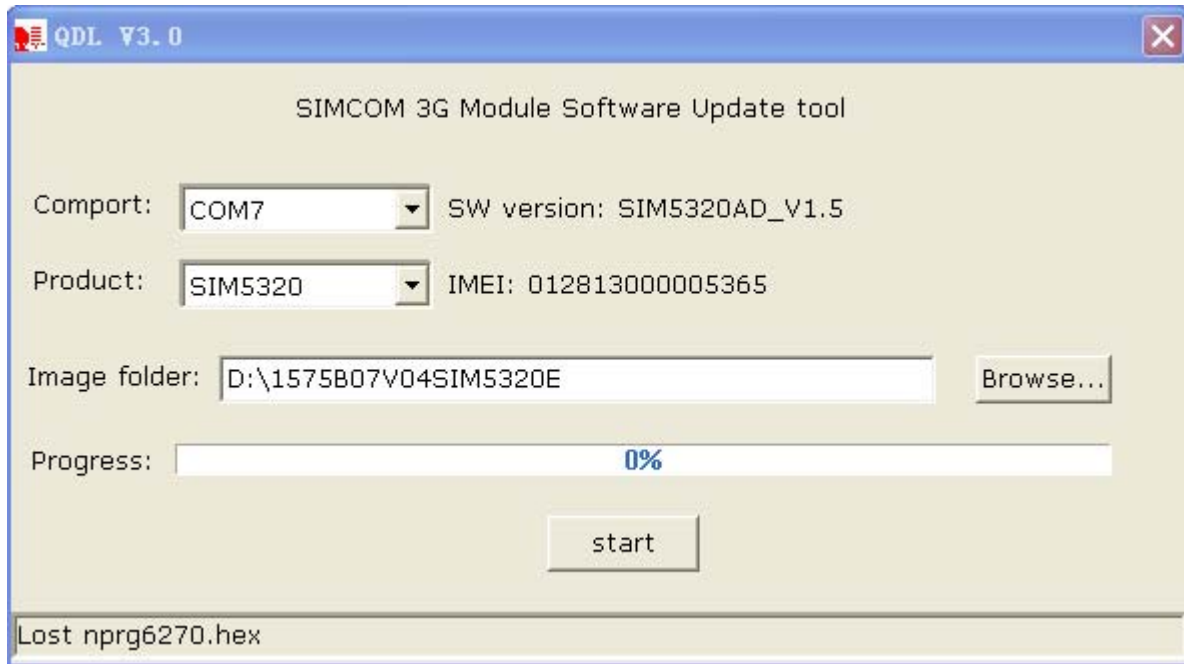
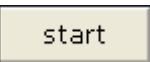


Figure 22: Browse the source file

- Software download

Click the  button, then the window will change like the following figure shows.

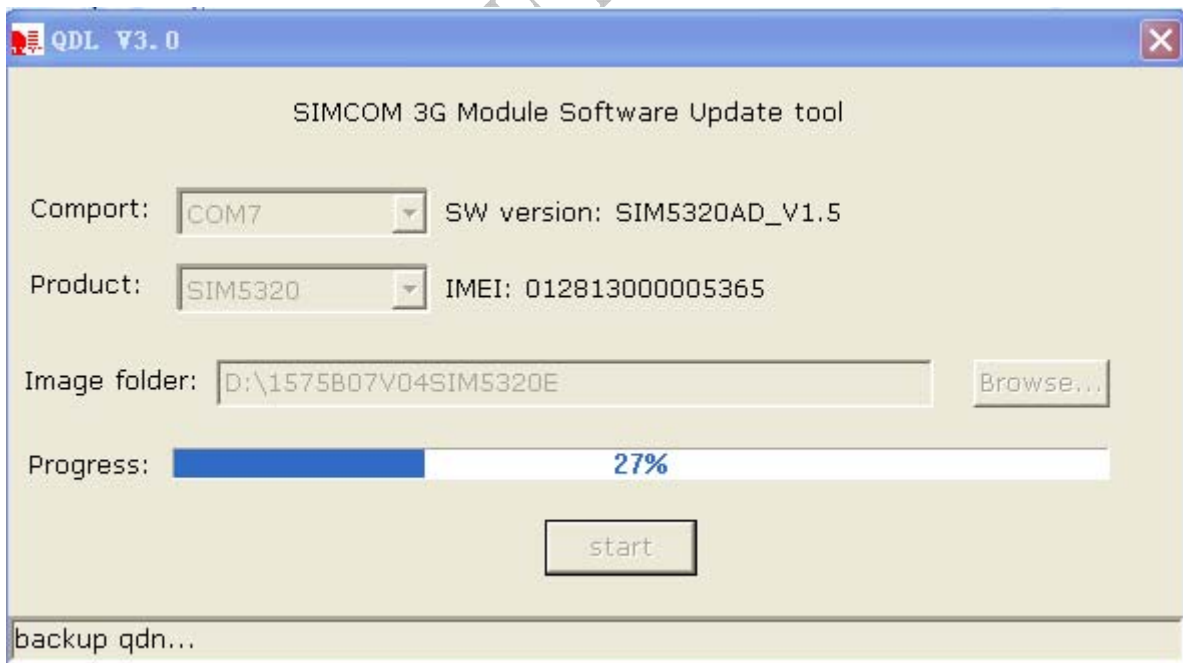


Figure 23: click download button without power up

- Upgrade in proceeding

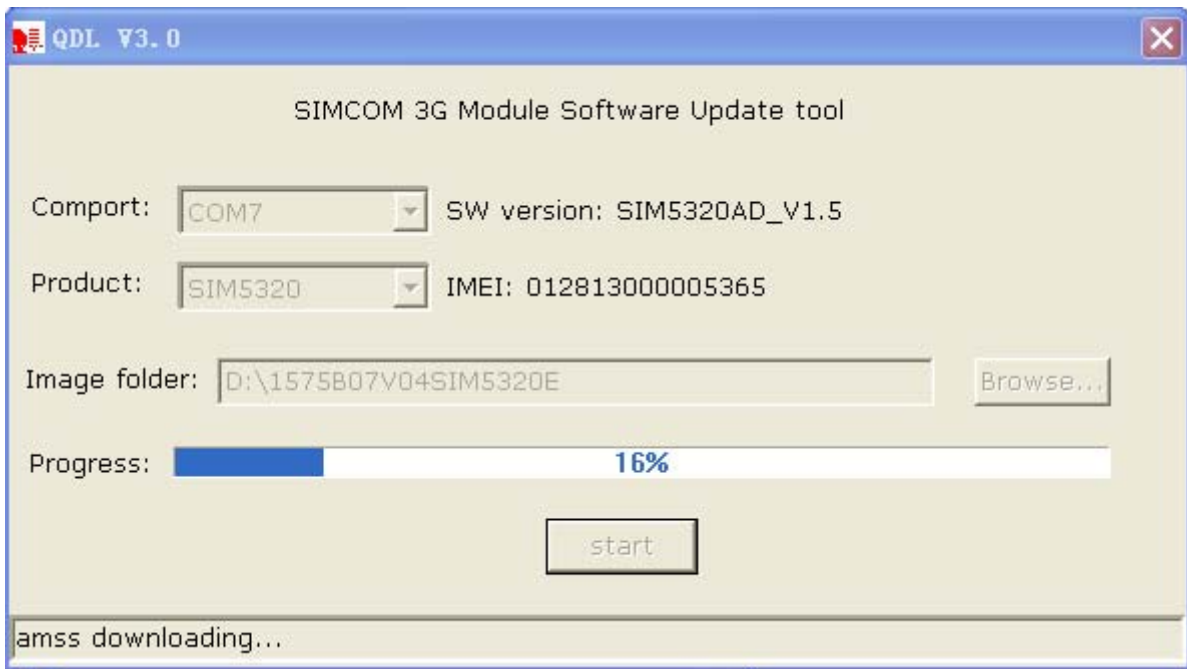


Figure 24: Upgrade in proceeding

- Finish upgrading

Now the software is the new version, customer can check the software version by “ATP”.

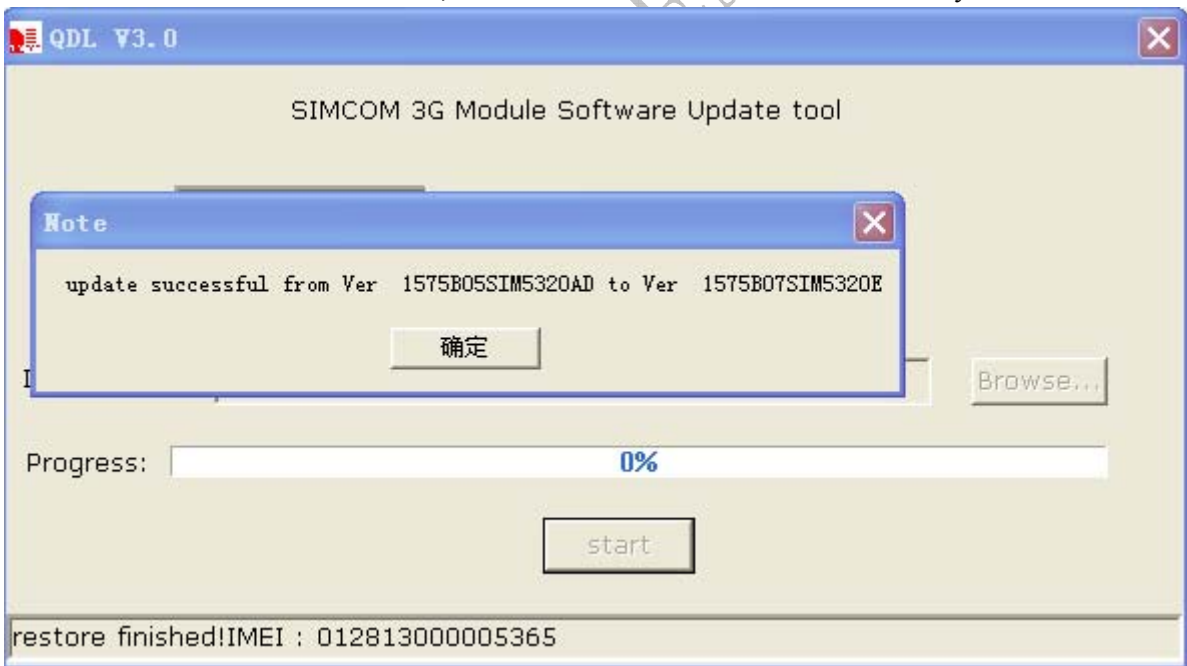


Figure 25: Finish upgrading

Appendix

A. Related Documents

Table 19: Related documents

SN	Document name	Remark
[1]	SIM5320_ATC_V1.00	SIM900 AT Command Manual
[2]	SIM5xxx_GPIO_Application_note	Applications Note About SIM5xxx_GPIO
[3]	Audio Application Note V1.01	Applications Note About T5320 Audio
[4]	ITU-T Draft new recommendation V.25ter	Serial asynchronous automatic dialing and control
[5]	GSM 07.07	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[6]	GSM 07.10	Support GSM 07.10 multiplexing protocol
[7]	GSM 07.05	Digital cellular telecommunications (Phase 2+); Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE – DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
[8]	GSM 11.14	Digital cellular telecommunications system (Phase 2+); Specification of the SIM Application Toolkit for the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[9]	GSM 11.11	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[10]	GSM 03.38	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[11]	GSM 11.10	Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification; Part 1: Conformance specification
[12]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[13]	3GPP TS 34.124	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[14]	3GPP TS 34.121	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[15]	3GPP TS 34.123-1	Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)
[16]	3GPP TS 34.123-3	User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.
[17]	EN 301 908-02 V2.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000. Third Generation cellular networks; Part 2: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (UE) covering essential requirements of article

		3.2 of the R&TTE Directive
[18]	EN 301 489-24 V1.2.1	Electromagnetic compatibility and Radio Spectrum Matters Electromagnetic Compatibility (EMC) standard for radio equipment and s Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UT Mobile and portable (UE) radio and ancillary equipment
[19]	IEC/EN60950-1(2001)	Safety of information technology equipment (2000)
[20]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station conformance specification
[21]	GCF-CC V3.23.1	Global Certification Forum - Certification Criteria
[22]	2002/95/EC	Directive of the European Parliament and of the Council of 27 January 200 restriction of the use of certain hazardous substances in electrical and el equipment (RoHS)

B. Terms and Abbreviations





Table 20: Terms and Abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
AMR	Adaptive Multi-Rate
AT	Attention commands
CS	Coding Scheme
CSD	Circuit Switched Data
CTS	Clear to Send
DTE	Data Terminal Equipment (typically computer, terminal, printer)
DTR	Data Terminal Ready
DTU	Data Transmit Unit
DTX	Discontinuous Transmission
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
FR	Full Rate
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HR	Half Rate
IMEI	International Mobile Equipment Identity
Li-ion	Lithium-Ion
MO	Mobile Originated
MS	Mobile Station (GSM engine), also referred to as TE
MT	Mobile Terminated
PAP	Password Authentication Protocol
PBCCH	Packet Broadcast Control Channel
PCB	Printed Circuit Board
PCL	Power Control Level

PCS	Personal Communication System, also referred to as GSM 1900
PDU	Protocol Data Unit
PPP	Point-to-point protocol
RF	Radio Frequency
RMS	Root Mean Square (value)
RTC	Real Time Clock
RX	Receive Direction
SIM	Subscriber Identification Module
SMS	Short Message Service
TE	Terminal Equipment, also referred to as DTE
TX	Transmit Direction
UART	Universal Asynchronous Receiver & Transmitter
URC	Unsolicited Result Code
USSD	Unstructured Supplementary Service Data
Phonebook abbreviations	
FD	SIM fix dialing phonebook
LD	SIM last dialing phonebook (list of numbers most recently dialed)
MC	Mobile Equipment list of unanswered MT calls (missed calls)
ON	SIM (or ME) own numbers (MSISDNs) list
RC	Mobile Equipment list of received calls
SM	SIM phonebook
NC	Not connect

C. Safety Caution

Table 21: Safety caution

Marks	Requirements
	When in a hospital or other health care facility, observe the restrictions about the use of mobiles. Switch the cellular terminal or mobile off, medical equipment may be sensitive to not operate normally for RF energy interference.
	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it is switched off. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. Forget to think much of these instructions may lead to the flight safety or offend against local legal action, or both.
	Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.
	Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.



Road safety comes first! Do not use a hand-held cellular terminal or mobile when driving a vehicle, unless it is securely mounted in a holder for hands free operation. Before making a call with a hand-held terminal or mobile, park the vehicle.



GSM cellular terminals or mobiles operate over radio frequency signals and cellular networks and cannot be guaranteed to connect in all conditions, for example no mobile fee or a invalid SIM card. While you are in this condition and need emergent help, please remember using emergency calls. In order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength.

Some networks do not allow for emergency call if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may have to deactivate those features before you can make an emergency call.

Also, some networks require that a valid SIM card be properly inserted in the cellular terminal or mobile.

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